W. I. A.—1. Issued June 18, 1915.

United States Department of Agriculture,
BUREAU OF PLANT INDUSTRY,
Western Irrigation Agriculture,
WASHINGTON, D. C.

THE WORK OF THE UMATILLA RECLAMATION PROJECT EXPERIMENT FARM IN 1914.

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INTRODUCTION.

The experiments carried on at the Umatilla Experiment Farm in 1914 followed the same general lines as those conducted in 1912 and 1913, as reported in previous publications.[2] On account of the small size of the farms on the Umatilla project, which contain an average of about 30 acres of irrigable land, it is necessary that systems of intensive agriculture be established. The climatic conditions on the project are well suited to the production of certain truck crops and fruits, to dairy farming, and to the rearing of hogs. One of the first requirements of successful crop production on this project is to increase the supply of organic matter in the soil, so as to improve the water-holding capacity and productivity and to lessen the danger of wind erosion. It is necessary also that crop varieties suited to the conditions on the project be found and that satisfactory methods be worked out for handling the soil and the irrigation water.

Since its establishment in 1909, the Umatilla Experiment Farm has been devoted to the investigation of these problems. The work of the farm has been mainly horticultural and is at present confined chiefly to the testing of varieties of fruits and truck crops and to investigating methods of producing them. Cover crops and methods of irrigation have also received attention. This publication contains a brief discussion of the progress of the work during the year 1914.

[1] The Umatilla Experiment Farm is located on the Umatilla Reclamation Project, about 2 miles north of Hermiston, Oreg. The farm contains 40 acres of land withdrawn from entry in 1908 by the Department of the Interior for use as an experiment farm. It is maintained and operated by the Oregon Agricultural Experiment Station in cooperation with the Bureau of Plant Industry, United States Department of Agriculture, under a cooperative agreement. Operations were begun in 1909. The buildings used were constructed by the United States Reclamation Service and by the Oregon Agricultural Experiment Station. The expenses of the farm are shared equally by the Oregon station and the Office of Western Irrigation Agriculture. The investigational work is under the immediate supervision of a farm superintendent who is a collaborator of the Bureau of Plant Industry.

[2] See Allen, R. W., "The Work of the Umatilla Experiment Farm in 1912," United States Department of Agriculture, Bureau of Plant Industry Circular 129, pp. 21–32, 1913; also "The Work of the Umatilla Reclamation Project Experiment Farm in 1913," an unnumbered circular of the Office of Western Irrigation Agriculture of the United States Department of Agriculture, issued Aug. 25, 1914.

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CONDITIONS ON THE PROJECT.

CLIMATIC CONDITIONS.

Measurements of precipitation, evaporation, wind velocity, and temperature have been made at the experiment farm in cooperation with the Biophysical Laboratory of the Bureau of Plant Industry since September, 1911. A summary of the climatological observations for the past three years is given in Table I.

TABLE I.—*Summary of climatological observations at the Umatilla Experiment Farm, 1912 to 1914, inclusive.*

PRECIPITATION (INCHES).

Year, etc.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1912	2.22	0.67	0.49	0.61	1.25	0.97	0.05	1.18	0.10	0.29	0.54	0.13	8.50
1913	1.69	.57	.23	.34	1.72	.78	Tr.	.52	.16	1.43	1.20	.62	9.26
1914	1.82	.54	.03	.96	.59	.34	.15	Tr.	.52	1.06	.31	.49	6.80
Average	1.91	.59	.25	.64	1.18	.69	.06	.56	.26	.92	.68	.41	8.18

EVAPORATION (INCHES).

1912	[1]	[1]	[1]	3.98	5.21	7.51	8.23	5.68	3.87	2.98	0.78	0.25	38.50
1913	[1]	[1]	1.98	3.70	5.85	5.90	8.53	7.13	5.06	2.06	.70	[1]	40.90
1914	[1]	[1]	2.88	3.89	6.21	7.07	8.42	7.05	4.10	1.76	[1]	[1]	41.98
Average	[1]	[1]	.....	3.85	5.75	6.82	8.39	6.82	4.34	2.26	.....	.....	.....

DAILY WIND VELOCITY (MILES PER HOUR).

Mean:													
1912	2.5	4.0	3.3	2.5	3.1	5.3	4.4	3.8	2.5	3.5	1.7	4.3	3.4
1913	3.1	2.5	4.7	5.2	3.7	4.5	3.8	3.0	2.2	2.3	2.1	1.2	3.3
1914	3.8	3.6	3.8	4.0	3.6	4.9	3.4	3.3	3.7	1.7	1.7	.98	3.2
Maximum:													
1912	8.7	12.7	16.9	15.7	10.5	13.6	11.5	9.7	9.5	12.3	5.1	15.4	16.9
1913	15.3	6.9	13.9	14.2	11.8	9.8	11.9	7.0	8.2	8.3	11.5	3.3	15.3
1914	10.8	13.0	14.0	12.7	10.6	10.7	9.9	13.7	11.1	5.7	13.4	3.3	14.0
Minimum:													
1912	1.2	.9	1.3	1.1	.9	.9	1.2	.8	.5	.6	.7	.5	.5
1913	.8	.5	1.0	1.4	1.1	1.3	.9	.5	.4	.4	.5	.3	.3
1914	.7	.8	.6	.8	.5	1.1	.9	.3	.2	.1	.1	.2	.5

MONTHLY TEMPERATURE (°F.).

Mean:													
1912	29	40	41	52	61	69	72	69	59	48	42	35	.....
1913	30	23	45	53	59	68	74	83	60	50	43	31	.....
1914	39	37	47	54	61	66	74	73	61	53	42	26	.....
Maximum:													
1912	52	58	71	78	91	104	102	102	87	78	62	63	104
1913	66	60	64	86	87	97	105	103	91	81	65	51	105
1914	63	64	70	75	91	100	104	104	91	78	66	54	104
Minimum:													
1912	−18	16	15	26	35	43	48	41	32	23	20	12	−18
1913	0	− 6	19	26	34	44	44	42	31	26	25	7	− 6
1914	21	12	20	26	33	35	44	42	37	31	22	− 4	− 4

[1] Record incomplete, owing to freezing of water.

The dates of the last spring frosts and first autumn frosts from 1909 to 1911, inclusive, were obtained from the local office of the Reclamation Service at Hermiston, about 2 miles from the experiment farm. From 1912 to 1914 the observations were made at the experiment farm. These data for the six years 1909 to 1914, inclusive, are given in Table II.

TABLE II.—*Killing frosts at Hermiston, Oreg., 1909 to 1914, inclusive.*

Year.	Last in spring.		First in autumn.		Frost-free period.
	Date.	Minimum temperature.	Date.	Minimum temperature.	
		°F.		°F.	Days.
1909	Apr. 21	27	Oct. 16	30	178
1910	Apr. 30	27	Oct. 15	31	168
1911	Apr. 20	31	Sept. 23	26	156
1912	Apr. 16	31	Oct. 6	31	173
1913	Apr. 23	28	Sept. 24	31	153
1914	Apr. 29	30	Oct. 20	31	184
Average					168

AGRICULTURAL CONDITIONS.

Warm weather caused early plant growth to occur and the crop of early blossoming varieties of all fruits was destroyed by a severe frost on April 20. The season was long and favorable for the rapid growth of plants. Four full crops of alfalfa were harvested.

Orchards already planted on the project are being maintained, but extensive planting has ceased, and attention is being devoted to industries that yield an earlier and more continuous return.

Much damage was done to orchards and forage crops by grasshoppers and rabbits. Grasshoppers made their appearance early and were distributed over the entire project. Various means of combating them were tried out and the best results followed the use of hopperdozers, distasteful sprays, and poultry.

A number of hopperdozers were built and operated with good results. Chickens and turkeys are very effective in destroying grasshoppers. If put on a field while the insects are young, they destroy large numbers and accomplish better results than if put to work after the insects are half grown or larger. Heavy applicatons of Bordeaux mixture checked the ravages of the insects on fruit trees, but did not entirely prevent the destruction of foliage.

The number of rabbits, which has been increasing for several years, became so great in 1914 that large areas of alfalfa and trees were destroyed by them. Many were killed by shooting, by the use of poisons, and by driving. A large amount of time and money was expended with satisfactory results, but the number has not yet been sufficiently reduced to prevent damage.

Ready sale was found for practically all products raised on the project. The supply of fruit, which was very small on account of the spring frost, was sold locally for good prices. Construction outfits operated by the Reclamation Service and the railroad company on or near the project purchased most of the surplus hay. Loose alfalfa sold at $7 to $8 per ton, while a few cars of baled hay brought $11 a ton, f. o. b., Hermiston.

Watermelons and potatoes were the principal truck crops marketed. Watermelons in car lots sold at first for $15 a ton and later at $10. Early potatoes brought from 2½ to 4 cents a pound and late varieties 1½ to 2¼ cents.

During the first seasons of development on the project orchards and alfalfa were extensively planted. Alfalfa hay was sold at good prices until the supply began to exceed the local demand. Since this condition occurred, a rapidly increasing interest has been taken in dairying and the raising of hogs as a profitable means of marketing the forage. In addition to giving better returns for the crops, feeding live stock also provides manure for the land, which is much needed by all soils of the project. The raising of live stock is also profitable because it affords continual employment for labor and provides a sure if moderate profit from the land.

In 1914 the total irrigable area of the 311 farms on the project was 9,410.6 acres, of which 5,101.6 acres were actually irrigated. The average irrigated area per farm was 16.4 acres. On the irrigated land a total of 2,088.2 acres was devoted to young orchards, newly seeded alfalfa, rye for green manure, and other crops not harvested, so that the total area from which crops were harvested was 3,013.4 acres. This was 205 acres less than the area harvested in 1912 and about the same as that harvested in 1913. The average farm value per acre of all the crops on the project was $29.41, as compared with $24 in 1912 and $27.72 in 1913. The acreage, yields, and farm values of the crops grown on the project in 1914 are stated in Table III, the figures being obtained from the United States Reclamation Service.

TABLE III.—*Acreage, yields, and farm values of crops grown on the Umatilla project in 1914.*

Crops.	Area (acres).	Unit of yield.	Yield.			Farm value.		
			Total.	Per acre.		Per unit of yield.	Total.	Average per acre.
				Average.	Maximum.			
Alfalfa	2,048	Ton	7,511	3.7	8	$8.00	$60,088	$29.34
Apples	53	Pound	29,682	556.8	8,000	.01⅔	494	9.28
Artichokes	3	Bushel	1,420	433.3	600	.36⅓	514	155.98
Clover hay	5	Ton	16	2.91	3.4	8.00	128	23.27
Clover seed	1	Bushel	1.5	1.5		14.00	21	21.00
Corn, Indian	51	do	1,800.5	34.9	100	.85½	1,539	29.83
Corn, fodder	80	Ton	244	3	15	3.40	829	10.30
Fruits, small	64	Pound	83,610	1,290.3	10,000	.05	4,180	64.51
Garden	38						4,726	122.44
Hay	110	Ton	108	.98	3.3	6.67	720	6.52
Melons	13	do	85.5	6.3	10	14.98	1,281	94.89
Onions	3	Bushel	628	179.4	266	.87½	547	156.55
Pasture	541						7,063	13.04
Peaches	117	Pound	52,000	441	4,000	.01½	780	6.62
Pears	7	do	2,262	301.6	480	.04	90	12.06
Potatoes	61	Bushel	5,618	91.5	400	.89	5,000	81.43
Rye	3	do	42	14	14	1.20	50	16.80
Wheat	7	Bushel	290	38.7	45	.98	284	37.89
Miscellaneous	26						275	10.22
Less duplications	227							
Total or average	3,013						88,613	29.41

A substantial increase occurred in the number of dairy cattle and in the quantity of dairy products sold from the farm during the year. The figures of the Hermiston creamery show that a monthly average of 10,156 pounds of butter fat was purchased at an average price of 30.9 cents a pound, which represents an annual income of $37,000.

An increase of 71 per cent in the number of hogs on the project shows a decided tendency among the farmers to participate in hog raising.

No difficulty was met with in disposing of animal products. The price of butter fat continued fairly uniform except for two brief periods in April and July, when it declined to 25 cents a pound.

The number and valuation of live stock on the Umatilla project on January 1, 1914, and December 31, 1914, are shown in Table IV. The figures in this table were obtained from the United States Reclamation Service.

The decrease in the total value of live stock on the project between January 1 and December 31, 1914, is due to the fact that more sheep and beef cattle were fed during the winter of 1913–14 than during the winter of 1914–15. On December 31, 1914, there were 641 dairy animals and 206 beef animals on the project.

TABLE IV.—*Number and value of live stock on the Umatilla project January 1 and December 31, 1914.*

Item.	Inventory, January 1.			Inventory, December 31.			Increase or decrease in total value.
	Number.	Value.	Total value.	Number.	Value.	Total value.	
Horses	549	$85.04	$46,667	633	$87.37	$55,305	$8,638
Mules	20	175.00	3,500	26	128.65	3,345	— 155
Cattle	884	62.92	55,632	847	58.65	49,680	— 5,952
Sheep	6,544	5.14	33,640	42	5.38	226	—33,414
Hogs	1,276	8.69	11,090	2,185	8.37	18,284	7,194
Fowls	10,426	.53	5,596	12,189	.63	7,735	2,139
Bees (hives)	329	4.18	1,375	464	4.28	1,988	613
Total	----------	----------	157,500	----------	----------	136,563	—20,937

RESULTS OF EXPERIMENTS.

LINES OF WORK.

The more important experiments conducted at the experiment farm in 1914 were as follows: (1) Tests to determine the most economical methods of handling irrigation water, (2) an alfalfa pasturing experiment with hogs, (3) the testing of a number of forage crops, (4) the testing of methods of handling a green-manure crop, (5) experiments on the size and method of pruning fruit trees, (6) variety tests of fruits and vegetables, and (7) the growing of numerous hardy trees and shrubs in order to determine their value for ornamental purposes and as windbreaks. The arrangement of the fields and the location of the experiments in 1914 are shown in figure 1.

IRRIGATION EXPERIMENTS.

By a series of experiments carried out on the Umatilla Experiment Farm to determine the movement of irrigation water in the soil and the amount and frequency of application necessary for optimum crop growth, some very important information has been obtained.

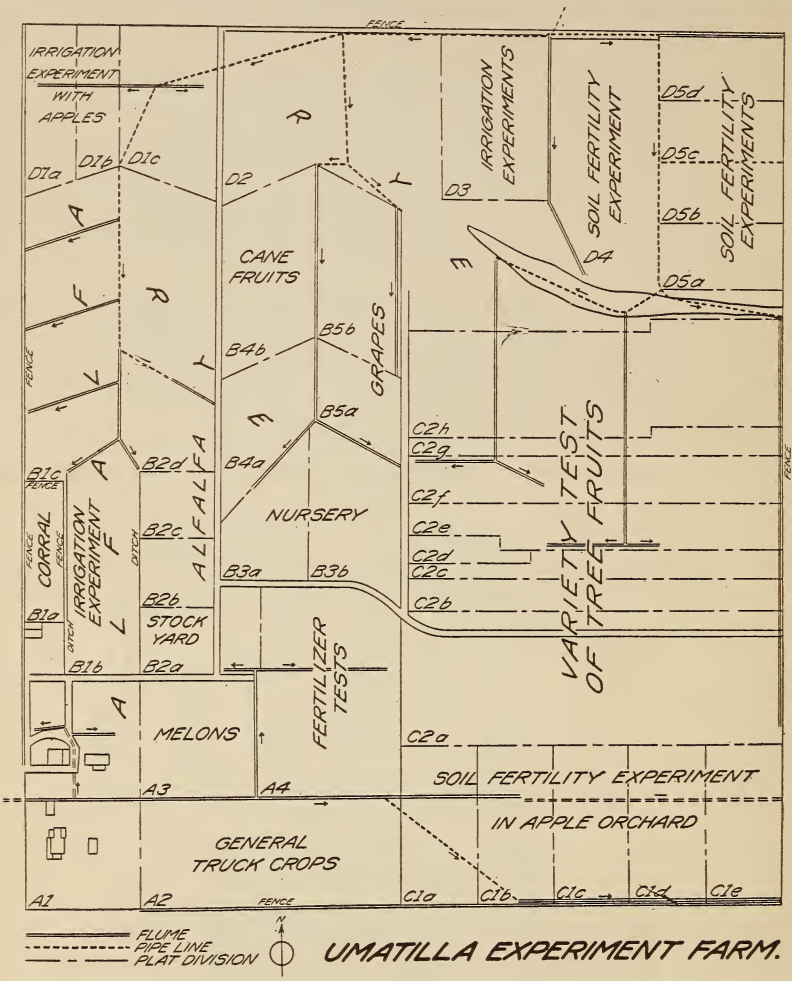

FIG. 1.—Diagram of the Umatilla Experiment Farm, showing the arrangement of the fields and the location of the experiments in 1914.

The conditions under which this work was conducted were as nearly ideal as it was possible to establish. An equal degree of economy can not be expected on the average farm, but the same general principles apply in all cases where the soil is of the same open, sandy character, with a gravelly subsoil, and much of the soil on the project may be so described.

It has been found that upon virgin land without crops a 2½-inch application of water is retained in the first 4 feet of soil. Five inches of water applied under identical conditions filled the first 10 feet to its full carrying capacity and part of the water passed even below this depth. Twenty-four hours after 5-inch and 10-inch applications of water were made on two plats having the same kind of soil there remained an equal quantity of water in each plat to the depth of 4 feet and this quantity was practically the same as was retained by the same layer of soil where a 2½-inch irrigation was applied.

On land of a finer texture and bearing a crop of alfalfa, a 4-inch application of water was all held in the upper 4 feet. This shows that in either case heavy losses result from applying heavy irrigations to the lighter soils of this project.

The careful irrigator who has his distribution system, furrows, head of water, and time properly arranged to enable him to apply just the quantity required to fill his soil to the depth of root penetration gets a maximum benefit from the water. On the other hand, the irrigator who uses more water at a time than his soil is capable of holding loses, by deep percolation, all of it that is not held within the root zone of his crop, and furthermore he may damage adjacent land by contributing to the underground seepage.

The frequency of applying water has a very marked influence upon crop yields. A plat of alfalfa given 4.4 feet of water at 8 applications yielded 4 tons of hay, or 0.92 ton per acre-foot of water used. Another plat given 5.3 acre-feet applied in 12 irrigations yielded 5.3 tons, or 1.02 tons per acre-foot of water. A third plat given 9.7 acre-feet of water in 24 irrigations yielded 5.57 tons, or 0.57 ton per acre-foot of water. Thus, the best results were obtained from 5.3 acre-feet of water applied in 12 irrigations.

Twelve irrigations, applied at 14-day intervals, with a total of 5.3 acre-feet of water, produced 78 per cent more per acre-foot of water used than was produced by 24 weekly irrigations aggregating 9.7 acre-feet of water. The excess of water and additional labor required to make 24 applications is not justified by the increase in yield resulting from such a treatment. Applications once in three weeks produced 0.92 ton per acre-foot of water and an acre yield of 4 tons. Because of the smaller crop, this might be considered a less economical use of the land, although it gives a higher value to the water applied.

To get the greatest benefit from irrigation water on these sandy soils it should be very carefully handled. The necessity for economical use requires that special emphasis be placed on (1) using short irrigation furrows, ranging from 100 to 200 feet in length; (2) making irrigation furrows 20 to 30 inches apart; (3) using fairly shallow furrows, well opened, to facilitate the flow of water; (4) running water

for but a short time in one place, as loss soon occurs from deep percolation; (5) the use of a small amount of water for each irrigation, since the storage capacity of the soil is very low; (6) the frequent application of water to maintain an adequate supply for plant growth, as the small quantity that it is possible to store in the soil is quickly taken up by the plants or evaporated; and (7) using a comparatively large stream of water while irrigating, in order to cover the land as quickly as possible.

ALFALFA PASTURING EXPERIMENT.

For the purpose of determining the value of hogs as a means of utilizing alfalfa, one-half acre of 4-year-old alfalfa was used. The soil and stand of plants were uniform over the plat, as no grading

FIG. 2.—Hogs in the alfalfa pasturing experiment, field C 1 e, Umatilla Experiment Farm, July 8, 1914.

was done preparatory to seeding. The tract was divided into two quarter-acre plats, one of which was used for the production of hay and the other fenced for pasture (fig. 2). The pastured plat was divided into two parts of one-eighth acre each, and the parts were pastured alternately.

The land was irrigated regularly at intervals of about 12 days. New furrows were made in the hay ground after each crop was removed and in the pasture plats before each irrigation.

Four crops of hay were cut from the one-fourth acre, the yield being at the rate of 5.3 tons per acre. A yield of 5.3 tons is considered large for such coarse sandy soil.

The four hogs of the first lot purchased for use in this experiment were farrowed September 15, 1913, so that they were 194 days old when placed on pasture. They were from the first litter of a young Duroc-Jersey sow. The sire was of the large-type Poland China breed, and both parents were of good stock. The four hogs of the second lot were similar in breeding to those of the first. Although not large for

their age, both lots were thrifty and in good flesh when put on the pasture. The hogs were fed 1½ pounds of rolled barley a day for each 100 pounds of live weight, in addition to the alfalfa pasture.

The first lot of hogs was on pasture from March 28 to August 11, a total of 135 days. The second lot was on pasture from August 11 to October 6, 55 days. The four hogs of the first lot averaged 84 pounds each when they were placed on the pasture on March 28, and at the end of the first pasturing period, August 11, their average weight was 190 pounds. The four hogs of the second lot averaged 89 pounds each on August 11 and 121 pounds each at the conclusion of the experiment on October 6. During the 190 days in the two periods the hogs gained a total of 573 pounds from the one-fourth acre of alfalfa, supplemented by 1,883 pounds of grain. The value of these gains, at 7 cents a pound, is $40.11. After deducting the cost of the grain fed, at $30 a ton, the net return from the alfalfa pasture was $11.87, which is equivalent to $47.48 per acre.

The results of this preliminary experiment indicate that it may be profitable to have hogs harvest a large part of the alfalfa produced on the project. In addition to the fair cash returns secured by pasturing the alfalfa with hogs, it should be remembered that this method saves the expense of harvesting the hay. The retention of all the fertilizer resulting from feeding approximately 7,500 pounds of grain and a quantity of green alfalfa equivalent to 5.3 tons of hay per acre and having it well distributed over the surface of this land in the form of manure is an item of great importance and value in this district.

All that can be gained in buying grain in quantity is clear profit. Grain should be bought directly from the producer and in large quantities. Where a return of $47.48 per acre was obtained for alfalfa pasture by feeding grain costing $30 a ton, a saving of $37.68 would have been made by feeding $20 grain, and an acre return of $85.10 would have been realized. From 1½ to 2½ pounds of grain should be fed daily for every 100 pounds of live weight. It is probable that the larger quantity is preferable.

For the comfort, protection, and health of the animals substantial shelter should be provided, and the quarters should be kept clean and well disinfected. Fresh water and some form of mineral matter should be available at all times. A combination of soft coal (or charcoal), salt, and a small amount of sulphur kept in a trough in the pasture is valuable for keeping the animals in a good thrifty condition. The animals should be changed from one plat of alfalfa to the other frequently, in order to keep them on succulent feed and to get a maximum growth of forage. If not fed down closely, the alfalfa should be clipped each time, as soon as the hogs are removed.

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FORAGE CROPS.

SUDAN GRASS.

Sudan grass is a member of the sorghum group of plants. It was introduced into the United States from the Sudan Government at Khartum for the production of forage on dry lands in the southern Great Plains States. Its requirements of climate are very similar to those of the grain sorghums, and, like them, it is strongly drought resistant. Sudan grass is an annual plant and hence must be seeded each year.

When one crop is harvested, another springs up very quickly. This habit renders it valuable for forage production. The number

FIG. 3.—Sudan grass in the test plat, field C 2 a, Umatilla Experiment Farm, Sept. 28, 1914.

of crops and the quantity of forage it will produce in a year depend largely upon temperature, length of season, and moisture supply.

The frequency of loss from bloat resulting from feeding green alfalfa has caused a large number of dairy herds to be carried through the summer without having green feed in any form. It was with a view to finding a rapid-growing crop that could be profitably used for soiling to supply succulent green feed for dairy cows during the summer that Sudan grass was given a trial.

A small plat of ground was sown on June 10. The seed germinated quickly and uniformly. Growth was slow for a time, but when the plants acquired strength it became much more rapid. This plat was not cut for hay, as the production of seed was considered of greater importance. Growth continued to be rapid and an average height of 5 feet was attained at maturity (fig. 3).

At the close of the growing season it was harvested, and yielded cured hay at the rate of 4,758 pounds per acre. Owing to late plant-

ing, many heads did not mature. Seed was produced at the rate of 508 pounds per acre after a small amount of shattering occurred.

From this trial Sudan grass appears to be a very promising crop for this district, especially for soiling purposes. It is worthy of further trial, as there is great need of some crop to fill the place for which it appears to be well adapted.

SORGHUM VARIETIES.

Four varieties of grain sorghum were grown to determine their value and comparative merits for use as forage in this district. The two reasons for trying these crops were (1) to find something desirable for silage that would not be seriously affected by cutworms, as is the Indian corn now in common use, and (2) to get something that would mature quickly and require a minimum of water. The four varieties selected were feterita, Dakota Amber sorghum, Dwarf kafir, and brown kaoliang. The brown kaoliang made a fairly rapid growth, but it produced only a small amount of foliage and bore but little seed, which was small and light. Dwarf kafir proved to be a long-season variety, requiring more time than Pride of the North corn for proper maturity. It has an abundance of foliage and if sufficiently matured might be valuable for the silo. It is small, however, and does not make a satisfactory yield. Dakota Amber proved to be a very short-season variety that produces a fair yield of seed and foliage about equal in quality to that of corn. This crop appears to be very successful and is worthy of more extensive trial. Feterita requires a somewhat longer season than Dakota Amber sorghum, is very uniform in growth, and produces seed and foliage about equal in quality to corn. This crop is hardy and prolific and also worthy of more extensive tests. What appears to be an objection to it is that much of the foliage near the base of the stalks dries before the crop is sufficiently matured for the silo.

Before these crops can be recommended for general use to take the place of corn they require further trial, but the results so far secured are sufficient to show that Dakota Amber sorghum and feterita are very desirable varieties. An apparent objection to their use is the manner in which the grain is exposed. It is frequently attacked by blackbirds and other seed-eating birds, which destroy large quantities of the grain.

Unsatisfactory results were obtained throughout the entire experiment with germination. It appears from this difficulty, which occurred at two different seedings in rather warm weather, that more or less trouble will result in getting a stand. Other experiments are to be made with a special view to finding the cause of the poor stands.

HAIRY VETCH AS A GREEN-MANURE CROP.[1]

Sandy orchard lands for which stable manure is not readily available can be cheaply and effectively built up by the use of hairy vetch as a green-manure crop. Its use is applicable to land that is to be planted to trees and to land upon which orchards are being developed. The high cost of seed has prevented this crop from gaining the popularity it should have for general use in commercial-orchard districts. While it produces an abundance of seed, this seed matures irregularly and shatters so freely that it is very difficult to harvest.

By proper management but one seeding is necessary to establish the crop in an orchard, where it can be kept indefinitely and made to produce a heavy crop each year. This can be accomplished by permitting all or a part of the plants to mature seed, which can be scattered over the land after the crop is mature. The amount of seed required to establish a crop depends upon what it is desired to accomplish the first year. If all or a large part of the resulting plants are permitted to go to seed, 10 pounds per acre is sufficient. If a large portion of the first crop is to be turned under and only a narrow strip kept in each space between the tree rows for seed, 25 to 30 pounds should be sown.

Hairy vetch is a hardy plant capable of withstanding extremes of cold and drought, and it will endure long, cold winters when planted in the fall. The best results are secured by planting from August 1 to September 15, as the plants then become well established, suffer a minimum of loss in winter, and make a vigorous growth in early spring.

Once the crop is established on a piece of land, the process of reseeding is very simple. At the proper season the dry plants are scattered about by means of a spring-tooth harrow or spike-tooth harrow, to distribute the seed. The land should then be harrowed or disked to cover the seed, furrowed off, and irrigated. Where strips are kept for seed their width and frequency in the orchard should be influenced by the number of vetch plants in each strip and the width of the spaces to be reseeded. As the seed is difficult to spread after it has fallen, two narrow strips should be kept in each 30-foot space between the trees or one wider strip in each 25-foot space.

One spring irrigation is necessary to produce a satisfactory growth of hairy vetch for use as green manure, and frequently two applications of water are necessary to produce a good crop of seed.

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[1] For a fuller discussion of vetch as a green-manure crop, see Oregon Experiment Station Bulletin No. 120.

As the vetch plants are tender and succulent, they decay readily when worked into the soil. It is advisable to allow them to reach full size before plowing them under, as a few days in April and May add greatly to growth and to the consequent fertilizer value of the crop. Early fall-sown crops are usually ready to turn under from April 20 to May 5.

Rye might be sown with vetch to prevent soil erosion, but in combining the two crops not to exceed 1 part of rye seed to 2 of vetch should be used; and a mixture of 1 to 3 is better, as rye frequently crowds out vetch.

There is a need for some form of shade crop that can be grown with a minimum of labor and of water to protect orchard soils during warm summer weather. When left to mature, vetch plants fall to the ground and form a close mat that affords an effective covering. The full value of hairy vetch for use in this manner as a shade crop has not been determined, but the crop gives promise of being effective. It would be economical of irrigation water and labor.

What has been said of hairy vetch for use in orchards applies also to vineyards and truck lands where manure is not available. The reseeding method is thoroughly practicable, as has been fully demonstrated at the experiment farm and by a number of orchardists. It is much cheaper than the annual purchase of expensive seed. One slight objection to the practice is that it makes the orchard appear neglected and poorly kept. This is of minor importance in comparison with the valuable results derived from the practice.

INFLUENCE OF SIZE AND METHOD OF PRUNING UPON THE GROWTH OF YOUNG FRUIT TREES.

For the purpose of determining the best size of trees to purchase and the height at which they should be cut to give the best results, a number of cherry and pear trees were planted in 1912. Vigorous 1-year-old stock of three sizes was selected. The large trees were over size, being 1 inch in diameter and 6 to 8 feet tall, the medium-sized lot were 3½ to 4½ feet tall, and the small ones 2 to 3 feet tall.

The large, small, and part of the medium-sized trees were cut off at the usual height of 18 inches when planted; one lot of medium-sized trees was cut at 6 inches above the union and another lot left unpruned. There were six trees in each lot planted. The average number and length of branches, the average linear branch growth in inches per tree, and the number of trees lost from each lot are shown in Table V.

TABLE V.—*Growth in 1913 and 1914 of cherry and pear trees planted in 1912 and cut off at different heights at the Umatilla Experiment Farm.*

Kind and size of trees.	Cut off at—	Year.	Average number of branches per tree.	Average length of branches.	Total linear growth of branches per tree.	Number of trees lost.
Cherries:				*Inches.*	*Inches.*	
Large	18 inches above ground.	1912	15	8	248	1
Do	do	1913	16	16.5	241	3
Medium	do	1912	25	11	274	0
Do	do	1913	13	18.7	243	0
Small	do	1912	38	4.3	163	0
Do	do	1913	9	11.5	139	0
Medium	6 inches above union	1912	17	17.2	297	0
Do	do	1913	13	17.2	223	0
Do	Not cut off	1912	20	3.8	76	0
Do	do	1913	11	10.4	114	1
Pears:						
Large	18 inches above ground.	1912	43	3.8	163	0
Do	do	1913	21	6.8	124	1
Medium	do	1912	50	4.3	217	0
Do	do	1913	17	9.6	165	1
Small	do	1912	38	4.3	163	0
Do	do	1913	14	8.6	124	0
Medium	6 inches above union	1912	23	10.7	247	0
Do	do	1913	13	11	149	0
Do	Not cut off	1912	19	3.1	59	3
Do	do	1913	12	3	39	0

The trees were all carefully pruned between the growing seasons of 1912 and 1913. Their performance in 1914 was very similar to that shown in Table V for the years 1912 and 1913. Five of the large cherry trees have been lost and the sixth is in bad condition, due to the drying out of the wood in the body.

With vigorous large, medium, and small sized cherry and pear trees the deductions from this experiment bear out the results obtained in field planting in that oversized trees are much less successful than smaller stocks of equal quality. They also show that fewer vigorous branches result from removing practically all the top from medium-sized trees at the time of planting in the field.

These results are of greatest value in connection with plantings on coarse, sandy soils, where trees are started with greater difficulty than under more favorable conditions. Trees cut at 18 inches in height frequently put out a large number of small branches, advance slowly, and are difficult to train. Cutting the trees close to the ground produces a small number of vigorous branches, which make it possible to train the trees easily and successfully.

It has been thoroughly demonstrated by this experiment and in general field planting that large trees are undesirable on account of the heavy losses that result. This is more particularly true with stone fruits than with apples and pears. It has also been definitely shown that upon planting trees on coarse soils better results will be obtained by cutting the trees off close to the union in order to force the first year's growth into a small number of branches. Trees should never be left standing at full height after planting, as they rarely survive, and when they do they make unsatisfactory growth.

THE SUMMER PRUNING OF FRUIT TREES.

Experiments have been conducted during the past three years to determine the effect of summer pruning upon the growth and training of fruit trees. The work was conducted along two lines: (1) Thinning the branches on bushy, slow-growing trees to influence a stronger growth in the branches left on the tree; and (2) heading back long slender branches on trees making a rapid and slender growth to strengthen them and to cause the trees to spread out. Care was taken in every operation to retain such branches as were required for the proper training of strong trees.

Thinning was found to be necessary on almost all varieties of cherries, quinces, and peaches, and on about half the pears, prunes, and apples. Vigorous-growing apricots, prunes, plums, and apples were headed back to spread the trees and prevent the branches from becoming too long and slender.

Thinning bushy and slow-growing trees.—The operation of thinning is as much one of training as winter pruning is considered to be, and equal care should be taken in selecting branches in which to direct the growth. It is difficult to state at what season the work should be done. The best results were obtained in this work from pruning in June and the early part of July. From this it is evident that pruning should be attended to early, so that a large portion of the season's growth will take place in the selected branches.

It was found necessary to go over the orchard about three weeks after pruning, to pinch back and check the growth of undesirable branches. The reason for heading back and not removing some branches that are unnecessary for the proper training of the tree is to avoid removing too much of the foliage. If large quantities of foliage are removed from weak trees their vigor and growth are frequently severely interfered with.

The general result of removing about half the branches from a bushy, slow-growing tree and removing the terminal bud of all but six or eight of the remaining branches was to produce a much stronger growth in the few branches retained. The results obtained from these experiments indicate that by following such a practice the size of weak-growing and bushy trees can be increased much faster than by winter pruning alone. It is an important practice for trees on coarse soils where slow growth and early fruiting frequently occur.

Heading back rapidly growing trees.—The season at which trees should be headed back varies with different kinds of fruit and, to a limited extent, with the age of the trees. When the trees are young, short portions of the branches are left in establishing the framework, and as they increase in age longer pieces of wood are necessary to space the branches properly. On this account the branches of

young trees can be pruned earlier than older ones, as the heading back should be done soon after they reach the place where forks are required or where a change of direction is necessary.

Cherries make a strong growth early in the season and need to be pruned in June to avoid removing a large amount of growth and to get satisfactory branching with substantial growth and full maturity of new wood. Apple trees grow more slowly than cherries, but usually continue active later in the season. Their action depends somewhat upon the variety. From one to four branches usually spring from each branch that is headed back. They do not grow as large as those on similarly treated cherry trees, but render the selection of branches easy during the winter pruning.

A few varieties of prunes require summer pruning in order to strengthen the wood and cause the trees to spread out. Their habit of growth varies greatly among individual trees and the treatment should be varied to suit the best needs of each tree.

All unnecessary branches should be removed at the time of pruning in summer, to force a strong growth from the branches that are headed back. It is necessary to follow summer pruning with a light pruning in winter so as to remove such branches as are taking an undesirable course.

By pruning during the growing season a large amount of the energy of the tree can be conserved. The usual method of pruning heavily in winter causes the removal of large quantities of wood, which by summer pruning can be largely avoided, with the result of developing the trees more rapidly than results from present practices. Summer pruning has the disadvantage of being necessary at a busy season, but if it proves to be of as much value as is indicated by these experiments it is fully justified.

VARIETIES OF FRUITS AND VEGETABLES.

FRUIT VARIETIES.

The work of developing and testing the value of fruit varieties for the district is progressing with some difficulties.

A difference in hardiness and vigor of growth of varieties is being observed. A greater difference, however, appears to result from soil conditions than from the natural adaptability of the varieties. Growth in general is slow except where an abundance of water is applied or in locations that receive a large amount of topsoil as a result of grading the land.

Grasshoppers attacked a large number of apple and pear trees and some of the cane fruits in 1914, inflicting severe injury by destroying the foliage. A hard frost in April destroyed the fruit and blossoms on the fruit trees and strawberry plants, and killed the grapevines to such an extent as to destroy the crop of all but the Vinifera varieties which had not been uncovered.

A record was made of the date of the appearance of blossoms on almost all the varieties of tree fruits, but as no fruit developed the quality of the fruit and the time of maturity could not be determined.

Work with the strawberry variety tests was discontinued. As no fruit was matured in 1914, the results given in the report for 1913 are final for this experiment.

PROGRESS OF TRUCK-CROP EXPERIMENTS.

Eggplant.—Eggplant was grown under glass-covered frames in the garden with results very similar to those obtained in a similar experiment reported in 1913. Work with this crop has shown (1) that strong, well-developed plants are best for transplanting in the field; (2) that an abundance of fertilizer increases vigor and yield; (3) that early plants produce earlier and more abundantly than late ones; and (4) that these plants should be started in a hotbed, as seed sown in the field does not give satisfactory stands and the plants develop slowly.

Abundant yields were obtained, which demonstrate the possibilities in growing eggplants. The greatest barrier to the rapid development of a large industry is that of insufficient demand. Eggplants are new to this region and extensive production can be developed only by educating the people to their use and proper preparation for the table before their desirability and value will be appreciated.

Watermelons.—The test in 1914, which included twelve varieties, showed three varieties, Tom Watson, Triumph, and Red-Seeded Russian, to be worthy of further trial. The first two are inferior to Kleckley Sweet (Monte Cristo) in quality, but they yield heavily and have very strong rinds. The Red-Seeded Russian is small but very early and is promising for lengthening the melon season by going on the market early.

Muskmelons.—About 60 per cent of the muskmelon plants in the test of 33 varieties were seriously dwarfed by an attack of a fungous disease, due to a species of Fusarium. Emerald Gem showed the strongest immunity to it by having a smaller number of dwarfed plants than any other variety. As a result of this test, Hoodoo, Petoskey, Hackensack, and Emerald Gem appear to be the most desirable varieties tried and range in importance in the order named. Muskmelons require a rich soil and should be planted on heavily fertilized fields.

SOME PROMISING TREES FOR WINDBREAKS.

A general need of some permanent form of windbreak to protect orchards and fields throughout the project has resulted in the planting of a large number of trees to determine their value for this purpose.

A general discussion of windbreaks applicable to the irrigated sandy soils of the Columbia River Valley is given in Oregon Agricultural Experiment Station Bulletin No. 125.

In a small consignment of stock received from the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture, four very promising trees have been found. Two poplars, *Populus alba*, S. P. I. No. 26812, and *Populus balsamifera suaveolens*, No. 22363, appear to be especially desirable. The first is a rapid-growing tree with an abundance of dark-green foliage resembling that of the quaking asp. The bark is white and very attractive. Its rapid growth, pyramidal habit, and abundant foliage render it very promising for use in windbreaks. This variety was introduced from Orianda, Crimea, Russia. *Populus balsamifera suaveolens*, introduced from Shiling, Chihli, China, is similar in habit of growth to *Populus alba*, but somewhat less vigorous. It has very dark green foliage with red leaf petioles and beautiful characteristic brown lines on the bark of young wood. It is very desirable for ornamental use and appears well adapted for windbreaks.

Two elms, *Ulmus pumila*, S. P. I. No. 22975, and *Ulmus* sp., No. 34063, have made very rapid growth. They are upright in character, but have relatively small leaves and few slender branches. Owing to their vigor and hardiness they are very desirable for ornamentals and might be used to advantage in large windbreaks. The Chinese elm, *Ulmus pumila*, was introduced from Fengtai, China, and the Karagatch elm, *Ulmus* sp., from Russian Turkestan.

An upright willow, *Salix* sp., S. P. I. No. 22450, introduced from Pautingfu, China, is an attractive plant for use in windbreaks. It has long, slender branches and the foliage is rather small and thinly distributed, but if these trees are planted close together they would doubtless be as useful as some of the large species of trees in a windbreak.

A general characteristic of the above-described trees is that they come into leaf very early in the spring. In 1914 they came into leaf from March 30 to April 6. They all appear to be vigorous, as their early growth has been very rapid, and are promising for a more extended trial upon the project.

Approved:

Wm. A. Taylor,

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April 16, 1915.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1915